Safety and Certification Approaches for Ethernet-based Aviation Databuses

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With the advent of higher-performance computing and communication systems, aircrafts will have the capability to process an unprecedented amount of information pertaining to performance, safety and efficiency. Flight instruments will be integrated to share information and to cooperate with each other. It is inevitable that a high-speed and versatile network infrastructure will be required in the next generation of aircrafts.

One COTS technology, Ethernet, is seen as potentially attractive in avionics systems, due to its high bandwidth, low wire counts, and low cost. It has been used in the Boeing 777 to transmit non-flight-critical data, and in the Boeing 767ER within a flight-critical display system. It will also be the backbone of the Airbus A3XX avionics and communications systems.

There are many safety concerns, however, when Ethernet is applied to flight-critical systems. The inherent nature of the Ethernet protocols can easily result in non-deterministic behavior and interference. These are significant technical hurdles that must be overcome before Ethernet will be a viable candidate as an aviation databus technology.

The project is aimed at a comprehensive investigation of the safety and certification issues of Ethernet-based aviation databuses. The design approaches of assuring reliable, accurate, and real-time communication services using COTS Ethernet hardware and software methods will be examined. Through model analyses of real-life avionics applications, we expect to gain an improved understanding of the potential safety issues and to provide enlightened guidance relative to network structures and operations. We will also consider the issues related to test strategy of Ethernet-based avionics databuses. A workload generator, which synthesizes traffic load profiles from avionics applications, will be developed. Instead of using real airborne instruments, the communication specification of several real-life avionics applications including autopilot, electronic flight instrument system (EFIS), flight management system (FMS), and communication radio, will be analyzed to establish a profile of message characteristics. The approach allows us to scale the communication requirements and adjust the traffic loads based on anticipated applications. The synthesized workload can then be supplied to Ethernet-based avionics databuses under various workload parameters. The other tools, which provide scheduling analysis and performance measurement, can be useful for certification and development phases. We will assess real-time needs and select suitable software and hardware platforms for the development tasks. The candidate RTOS include WRS's VxWorks, Honeywell's DEOS, and other RTOS for avionics applications.

Collaborative relationships with standards working groups, the aerospace industry, and regulatory agencies will be sought in the project. Through this process, the relevant concerns can be discussed and addressed, and an industry-wide effort to define a safe Ethernet-based aviation database network can be initiated.